Claims

What is claimed:

1. A photocurable composition comprising:

    (a) an cationically curable compound;

    (b) an acrylate-containing compound;

    (c) a hydroxyl-containing compound;

    (d) a cationic photoinitiator; and

    (e) a free radical photoinitiator;

    wherein said composition has less than 0.54 equivalents of cationically curable groups, less than 0.10 equivalents of acrylate groups and less than 0.10 equivalents of hydroxyl groups per 100 grams of said composition.

2. The photocurable composition of claim 1, wherein said cationically curable compound is an epoxy-containing compound, and said cationically curable groups are epoxy groups.

3. The photocurable composition of claim 2, wherein said epoxy-containing compound is a difunctional non-glycidyl epoxy.

4. The photocurable composition of claim 3, wherein said difunctional non-glycidyl epoxy is cycloaliphatic.

5. The photocurable composition of claim 4, wherein said cycloaliphatic difunctional non-glycidyl epoxy is 3,4-epoxycyclohexylmethyl-3',4'-epoxycyclohexanecarboxylate.

6. The photocurable composition of claim 1, wherein said acrylate-containing compound is a difunctional (meth)acrylate.

7. The photocurable composition of claim 6, wherein said difunctional (meth)acrylate is aliphatic or aromatic.

8. The photocurable composition of claim 7, wherein said difunctional (meth)acrylate is a bisphenol A-based epoxy diacrylate.

9. The photocurable composition of claim 1, wherein said hydroxyl-containing compound is difunctional.

10. The photocurable composition of claim 9, wherein said difunctional hydroxyl-containing compound is a polyether polyol.

11. The photocurable composition of claim 10, wherein said polyether polyol is a polytetramethylene glycol having a molecular weight of between 250 and 2000.

12. The photocurable composition of claim 1, wherein said cationic photoinitiator is a mixture of S,S,S,S'-tetraphenylthiobis(4,1-phenylene)disulfonium dihexafluoroantimonate and diphenyl(4-phenylthiophenyl)sulfonium hexafluoroantimonate.

13. The photocurable composition of claim 1, wherein said free radical photoinitiator is a cyclohexyl phenyl ketone.

14. The photocurable composition of claim 13, wherein said cyclohexyl phenyl ketone is 1-hydroxycyclohexyl phenyl ketone.

15. The photocurable composition of claim 1, further comprising a reactive filler.

16. The photocurable composition of claim 15, wherein said filler has a crosslinked polysiloxane core.

17. The photocurable composition of claim 1, further comprising a stabilizer.

18. The photocurable composition of claim 17, wherein said stabilizer is 2,6-di-tert-butyl-4-hydroxytoluene and/or N,N-Dimethylbenzylamine.

19. The photocurable composition of claim 1, which does not comprise any tri-functional or higher acrylates.

20. The photocurable composition of claim 1, wherein said composition after imaging, curing and storage at 25°C and 50% relative humidity has a tensile strength that increases by less than about 21% over 51 days.

21. The photocurable composition of claim 1, wherein said composition after imaging, curing and storage at 25°C and 50% relative humidity has a tensile modulus that increases by less than about 14% over 51 days.

22. The photocurable composition of claim 1, wherein said composition after imaging, curing and storage at 25°C and 50% relative humidity has an elongation at break that decreases by less than 47% over 51 days.

23. The photocurable composition of claim 1, wherein said composition has about 0.46 to about 0.51 equivalents of cationically curable groups per 100 grams of said composition.

24. The photocurable composition of claim 1, wherein said composition has about 0.048 to about 0.080 equivalents of acrylate groups per 100 grams of said composition.

25. The photocurable composition of claim 1, wherein said composition has about 0.03 equivalents of hydroxyl groups per 100 grams of said composition.

26. A three-dimensional article produced by the process of claim 25.

27. A photocurable composition comprising:

(a) about 40% to about 80% by weight of a difunctional non-glycidyl epoxy;

(b) about 15% to about 35% by weight of a difunctional (meth)acrylate;

(c) about 10% to about 20% by weight of a difunctional hydroxyl-containing compound;

(d) a cationic photoinitiator; and

(e) a free radical photoinitiator.

28. The photocurable composition of claim 27, wherein said difunctional non-glycidyl epoxy is a cycloaliphatic epoxy.

29. The photocurable composition of claim 28, wherein said cycloaliphatic difunctional non-glycidyl epoxy is 3,4-epoxycyclohexylmethyl-3',4'-epoxycyclohexanecarboxylate.

30. The photocurable composition of claim 27, wherein said difunctional (meth)acrylate is aliphatic or aromatic.

31. The photocurable composition of claim 30, wherein said difunctional (meth)acrylate is a bisphenol A-based epoxy diacrylate.

32. The photocurable composition of claim 27, wherein said difunctional hydroxyl-containing compound is a polyether polyol.

33. The photocurable composition of claim 32, wherein said polyether polyol is a polytetramethylene glycol having a molecular weight of between 250 and 2000.

34. The photocurable composition of claim 27, wherein said cationic photoinitiator is a mixture of S,S,S,S'-Tetraphenylthiobis(4,1-phenylene)disulfonium dihexafluoroantimonate and diphenyl(4-phenylthiophenyl)sulfonium hexafluoroantimonate.

35. The photocurable composition of claim 27, wherein said free radical photoinitiator is a cyclohexyl phenyl ketone.

36. The photocurable composition of claim 35, wherein said cyclohexyl phenyl ketone is 1-hydroxycyclohexyl phenyl ketone.

37. The photocurable composition of claim 27, further comprising 0 to 12% by weight of a glycidyl ether.

38. The photocurable composition of claim 27, further comprising 0 to 10% by weight of a reactive filler.

39. The photocurable composition of claim 38, wherein said filler has a crosslinked polysiloxane core.

40. The photocurable composition of claim 27, further comprising a stabilizer.

41. The photocurable composition of claim 40, wherein said stabilizer is 2,6-Di-tert-butyl-4-hydroxytoluene and/or N,N-Dimethylbenzylamine.

42. The photocurable composition of claim 27, which does not comprise any tri-functional or higher acrylates.

43. The photocurable composition of claim 27, wherein said composition after imaging, curing and storage at 25°C and 50% relative humidity has a tensile strength that increases by less than about 21% over 51 days.

44. The photocurable composition of claim 27, wherein said composition after imaging, curing and storage at 25°C and 50% relative humidity has a tensile modulus that increases by less than about 14% over 51 days.

45. The photocurable composition of claim 27, wherein said composition after imaging, curing and storage at 25°C and 50% relative humidity has an elongation at break that decreases by less than 47% over 51 days.

46. A process for producing a three dimensional article in sequential cross-sectional layers in accordance with a model of the article, the process comprising the steps of:

(1) forming a first layer of the photocurable composition of claim 1;

(2) exposing said first layer to actinic radiation in a pattern corresponding to a respective cross-sectional layer of the model sufficient to harden the first layer in the imaged area;

(3) forming a second layer of said composition above the hardened first layer;

(4) exposing said second layer to actinic radiation in a pattern corresponding to a respective cross-sectional layer of the model sufficient to harden the second layer in the imaged area; and

(5) repeating steps (3)-(4) to form successive layers as desired to form said three dimensional article.

47. A three-dimensional article produced by the process of claim 46.

48. A process for bonding two or more digital versatile disc (DVD) layers together, the process comprising the steps of:

(1) combining the components of the photocurable composition of claim 1 to form a flowable or thixotropic mixture;

(2) applying the mixture to form a bonding layer positioned between two DVD layers to be bonded together;

(3) curing the photocurable composition with actinic radiation; and

(4) optionally pressing together the two DVD layers having the cured bonding layer between them.

49. The process according to claim 48, wherein the photocurable composition is cured with UV radiation at a dose of about 0.2-1.0 J/cm2.

50. The process according to claim 49, wherein the photocurable composition is cured with UV radiation at a dose of about 0.4 J/cm2.

51. A digital versatile disc produced by the process of claim 48.

52. A process for forming a three-dimensional article in sequential cross-sectional layers in accordance with a model of the article, the process comprising the steps of: jet depositing droplets of the photocurable composition of claim 1 onto a substrate in a pattern corresponding to a respective cross-sectional layer of the model so that adjacent droplets merge together; repeating these steps to form successive layers; and applying actinic radiation to cure the photocurable composition, pixel-by-pixel, line-by-line, layer-by-layer, after several layers have been formed and/or after all desired layers have been formed.

53. A three-dimensional article produced by the process of claim 52.

54. A process for forming a three-dimensional article in sequential cross-sectional layers in accordance with a model of the article, the process comprising the steps of: defining a layer of powder material onto a substrate; jet depositing the photocurable composition of claim 1 onto the powder layer in a pattern corresponding to a respective cross-sectional layer of the model; repeating these steps to form successive layers; and applying actinic radiation to cure the photocurable composition, pixel-by-pixel, line-by-line, layer-by-layer, after several layers have been formed and/or after all desired layers have been formed.

55. A three-dimensional article produced by the process of claim 54.

56. The process of claim 54 characterized in that the powder comprises a reactive component that reacts with the photocurable composition of claim 1, or is facilitated by the photocurable composition to react with itself.

57. The process of claim 54, wherein the power is comprised of a photocurable composition of claim 1.

58. A process for producing a coated optical glass fiber, the process comprising the steps of: applying the photocurable composition of claim 1 to the optical glass fiber; and curing the photocurable composition with actinic radiation.

59. A coated optical glass fiber produced by the process of claim 58.

60. A process for sealing a light emitting diode, the process comprising the steps of: applying the photocurable composition of claim 1 between a P-type semiconductor and an N-type semiconductor; and curing the photocurable composition with actinic radiation.

61. A sealed light emitting diode produced by the process of claim 60.

62. A paste comprising a curable, reactive wax and the photocurable composition of claim 1.

63. The paste of claim 62, wherein the curable, reactive wax includes a reactive moiety selected from the group consisting of hydroxyl, carboxyl, isocyanato, thiol, amino, epoxy, and vinyl.